APPARATUS AND METHODS FOR PAD ASSEMBLIES FOR EXERCISE MACHINES

TECHNICAL FIELD

The present invention relates to apparatus and methods for pad assemblies for exercise machines, and more specifically, to pad assemblies that provide improved pressure distribution characteristics during an exercise.

BACKGROUND OF THE INVENTION

The convenience, efficiency, and safety of exercise machines are widely recognized. Many different types of exercise machines are in use today. Some models have a single exercise station, while other models include multiple exercise stations at which a user may perform one or more exercises for developing and toning different muscle groups.

Many exercise machines include one or more pad assemblies that engage against portions of the user's body during an exercise. For example, Figure 1 shows an exercise machine 42 in accordance with the prior art. This exercise machine 42 may be used for developing arm and leg muscles, and includes a support frame 44 with a seat 46, and a pair of swing arms 48 rotatably coupled to the support frame 44. Each swing arm 48 includes a stirrup 50 for receiving one of the user's feet, a leg pad 52, and a cylindrical arm pad 54. The arm and leg pads 54, 52 are attached to a support 49 of the swing arm 48. An elastic band 56 is attached between the two swing arms 48.

For leg exercises, a user (not shown) may sit on the seat 46 with the user's feet inserted into the stirrups 50, and with an outer portion of each of the user's legs engaged with the leg pads 52. As the user forces the outer portion of the user's leg against one of the leg pads 52, the swing arm 48 pivots outwardly and stretches the elastic band 56. When the force is relaxed, the elastic band 56 moves the swing arm 48 inwardly to an initial, resting position. Alternately, for

arm exercises, the user places a portion of the user's arm (*e.g.* the forearm or hand) against one of the cylindrical arm pads 54 and applies an outwardly-directed force, causing the swing arm 48 to pivot outwardly and stretching the elastic band 56. Exercise machines of the type shown in Figure 1 are more fully described in U.S. Patent No. 5,409,439 issued to Lee.

Many other models of exercise machines include pad assemblies that are firmly engaged against various portions of a user's body during an exercise. For example, U.S. Patent No. 4,776,587 to Carlson *et al.* discloses an exercise device having a pair of leg pad assemblies that bear against the user's shins during a leg extension exercise. Similarly, U.S. Patent No. 4,509,746 to Mask teaches exercise machines having a flat leg pad that bears against the back of the user's calf during a leg curl exercise. Further, U.S. 5,716,308 to Lee teaches an exercise machine having a pair of cylindrical arm pads that engage inside surfaces of a user's arms during a chest or "fly" exercise, and in U.S. Patent No. 5,135,457 issued to Caruso teaches leg exercise machines having pad assemblies that engage a user's shoulders and knees during a leg exercise. Many other examples of exercise machines having pad assemblies that engage portions of a user's body during an exercise are known.

One disadvantage of prior art pad assemblies is that during an exercise, the compressive force applied by the user on the pad assembly does not remain uniformly distributed over the associated portion of the person's body. For example, Figure 2 shows an enlarged, partial cross-sectional view of a swing arm 48 of Figure 1 engaged with portions of a user's body. Specifically, the upper portion of Figure 2 shows a cross-sectional view of a user's forearm 58 engaged with the arm pad 54 during an arm exercise. As the user applies force against the arm pad 54, the outer surface of the arm pad 54 is compressed from an initial position 60 to a compressed position 62. The pressure (*i.e.* force per unit area) on the user's forearm 58 during the arm exercise is greatest at a peak-pressure area (or point) 64 that typically corresponds to the most highly compressed portion of the arm pad 54. The pressure on the user's forearm 58

decreases from the peak-pressure area 64 over those portions of the user's forearm 58 that are spaced apart from the peak-pressure area 64 and that are in contact with less-compressed portions of the arm pad 54.

Similarly, the lower portion of Figure 2 shows a cross-sectional view of a user's leg 66 engaged against the leg pad 52 during a leg exercise. During the exercise, the outer surface of the leg pad 52 is compressed from an uncompressed position 68 to a compressed position 70. As with the user's forearm 58 in the previous example, the pressure on the user's leg 66 is greatest at a peak-pressure area (or point) 72 usually corresponding to the most highly compressed portion of the leg pad 52, and decreases from the peak-pressure area 72 over those portions of the user's leg 66 that are in contact with less compressed portions of the leg pad 52. Thus, even though the uncompressed position 68 of the surface of the leg pad 52 is a contoured surface adapted to approximately conform to the shape of the user's leg 66, the leg pad 52 does not compress uniformly and the pressure distribution over the user's leg 66 is substantially non-uniform.

Because the compression forces are not more evenly distributed over the relevant portions of the user's forearm 58 and leg 66 during the arm and leg exercises, the user may experience discomfort, or may otherwise experience reduced satisfaction with the exercise machine. Therefore, pad assemblies that more evenly distribute the compression forces over the relevant portions of the user's body during an exercise would have utility over the prior art devices.

SUMMARY OF THE INVENTION

The present invention is directed to apparatus and methods for pad assemblies for exercise machines. In one aspect, a pad assembly for an exercise machine includes a layer of compressible padding having a first surface adapted to engage a portion of a user's body and a second surface opposite from the first surface. A backing structure is attached to the layer of compressible padding and

has a backing surface proximate the second surface. The backing surface is shaped to provide an approximately uniform-thickness portion of the layer of compressible padding when a compression force is applied to the first surface during an exercise. The approximately uniform-thickness portion may be coextensive with the portion of the first surface that engages with the user's body.

In another aspect, an exercise machine in accordance with the invention includes a support frame having a fixed portion and a moveable portion moveably coupled to the fixed portion, a load coupled to the moveable portion, and at least one pad assembly attached to the support frame. The pad assembly includes a layer of compressible padding having a first surface adapted to engage a portion of a user's body, and a backing member attached to a second surface of the layer of compressible padding opposite from the first surface. The backing member has a backing surface engaged with the second surface of the layer of compressible padding that is at least partially contoured such that a compression force applied against the first surface provides an approximately uniform-thickness portion of the layer of compressible padding.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an isometric view of an exercise machine in accordance with the prior art.

Figure 2 is an enlarged, partial cross-sectional view of the exercise machine of Figure 1 engaged with portions of a user's body during an exercise.

Figure 3 is an enlarged, partial cross-sectional view of arm and leg pad assemblies in accordance with two embodiments of the invention.

Figure 4 is a schematic side elevational view of a leg exercise machine having a pad assembly in accordance with an embodiment of the invention.

Figure 5 is an enlarged isometric view of a leg yoke of the leg exercise machine of Figure 4.

Figure 6 is a top plan view of the leg yoke of Figure 5.

Figure 7 is a lower isometric view of an embodiment of a pad assembly of the leg exercise machine of Figure 4.

Figure 8 is an exploded, cross-sectional end view of the pad assembly of Figure 7 taken along line 8-8.

Figure 9 is a partial isometric view of another embodiment of a pad assembly of the leg exercise machine of Figure 4.

Figure 10 is a top plan view of the leg yoke of Figure 5 engaged with a user's legs.

Figure 11 is a lower isometric view of a leg pad in accordance with an alternate embodiment of the invention.

Figure 12 is a partial isometric view of the leg pad of Figure 11 installed on an exercise machine.

Figure 13 is a cross-sectional view of the leg pad of Figure 11.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is generally directed to apparatus and methods for improved pad assemblies for exercise machines. Many specific details of certain embodiments of the invention are set forth in the following description and in Figures 3-13 to provide a thorough understanding of such embodiments. One skilled in the art will understand, however, that the present invention may have additional embodiments, or that the present invention may be practiced without several of the details described in the following description.

Figure 3 is an enlarged, partial cross-sectional view of arm and leg pad assemblies 100, 150 in accordance with two embodiments of the invention. In this example, the arm and leg pad assemblies 100, 150 are shown installed on a swing arm 48 of the arm and leg exercise machine 42 described above and shown in Figures 1 and 2. As shown in the upper portion of Figure 3, the arm

pad assembly 100 includes a backing structure 102 that is attached to the support 49 of the swing arm 48. A resilient, compressible layer 104 is attached to the backing structure 102. The backing structure 102 includes a non-planar (*e.g.* contoured) surface 106 that supports the compressible layer 104 against compression forces applied to an outer surface 108 of the compressible layer 104.

In this embodiment, the backing structure 102 is an axisymmetric structure having an approximately "hour-glass" shape. The backing structure 102 may be formed of any suitable, sufficiently rigid material, including metal, wood, plastic, or the like. Similarly, the compressible layer 104 may be composed of any known padding material, preferably a material that provides suitable resiliency and compressibility for extended use in a high-use exercise environment. The compressible layer 104 may be composed of, for example, foam or rubber padding, and may include an outer layer of neoprene, cordura, nylon, or other suitable protective covering material.

In operation, a user engages an arm 58 against the outer surface 108 and applies a force against the arm pad assembly 100, compressing the outer surface 108 from an uncompressed position 60 to a compressed position 62. In this embodiment, in the uncompressed position 60, the compressible layer 104 does not have a uniform thickness between the outer surface 108 and the non-planar surface 106 of the backing structure 102. In the compressed position 62, the compressible layer 104 is compressed against the non-planar surface 106 of the backing structure 102 such that at least a portion 110 of the compressible layer 104 has an approximately uniform thickness between the user's arm 58 (*i.e.* the compressed position 62) and the non-planar surface 106. In the approximately uniform-thickness portion 110, the pressure distribution on the user's arm 58 is approximately uniform.

In general, it should be noted that the approximately uniform-thickness portion 110 need not be of an exactly uniform thickness, and that the actual thickness values of the compressible layer 104 within the approximately uniform-thickness portion 110 may vary without perceptibly changing the

pressure distribution on the portion of the user's arm 58 that contacts the pad assembly 100. The arm pad assembly 100 advantageously improves the pressure distribution on the user's arm 58 during an exercise. Because the non-planar surface 106 of the backing structure 102 provides an approximately uniform-thickness portion 110 of the compressible layer 104 when the layer 104 is in the compressed position 60, an improved distribution of the compression force applied by the user may be achieved. The pressure exerted on the user's arm 58 within the approximately uniform-thickness portion 110 may be less than that which occurs at the peak-pressure area 64 (Figure 2) of the prior art device, and may be approximately uniform over this area of the user's arm 58. Because the arm pad assembly 100 more evenly distributes the compression forces over the part of the user's arm 58 engaged against the approximately uniform-thickness portion 110 compared with the prior art arm pad 54, the user is less likely to experience discomfort during an exercise. Thus, the user's satisfaction with the exercise machine may be enhanced.

The shape of the non-planar surface 106 may vary widely depending on several variables, including the anticipated shape of the portion the user's body the pad assembly is intended to engage, the anticipated forces on the pad assembly, the shape of the outer surface of the compressible layer 104, and other characteristics of the compressible layer 104. In the embodiment shown in Figure 3, for example, the non-planar surface 106 is concavely-shaped to provide an approximately uniform-thickness portion 110 that engages only a portion of the surface of the user's arm 58 that contacts the compressible layer 104. In alternate embodiments, the shape of the non-planar surface 106 may be tailored to provide an approximately uniform-thickness portion that is larger or smaller than the portion 110 shown in Figure 3, including a portion that is co-extensive with the entire surface of the user's arm 58 that contacts the compressible layer 104. The non-planar surface 106 may have an increased or decreased concavity from that shown in Figure 3, and may have a varying or non-uniform concavity.

Referring again to Figure 3, the leg pad assembly 150 includes a backing structure 152 that has a contoured (or non-planar) surface 156, and a compressible member 154 attached to the contoured surface 156. In this embodiment, the contoured surface 156 is shaped such that when the compressible member 154 is compressed during use, the contoured surface 156 provides an approximately uniform-thickness portion 160 of the compressible member 154 that is co-extensive with the contact surface between the user's leg 66 and the compressible member 154. The pressure exerted on the user's leg 66 may be approximately uniformly distributed over the approximately uniform-thickness portion 160, and may be less than that which occurs at the peak-pressure area 72 of the prior art leg pad 52 (Figure 2). In addition, the contoured surface 156 may cooperate with the non-planar outer surface (*i.e.* the uncompressed position 68) of the compressible member 154 to provide a more even pressure distribution over the relevant portion of the user's body during an exercise.

Figure 4 is a schematic side elevational view of a leg exercise machine 200 including a pair of pad assemblies 250 (only one visible) in accordance with another embodiment of the invention. The leg exercise machine 200 includes a bench 202 and a fixed support 204 positioned near an end of the bench 202. A leg yoke 210 is pivotably attached to the fixed support 204 and includes pad assemblies 250. A cable 205 has a first end attached to the leg yoke 210 and a second end attached to a training load 208 (*e.g.* a weight stack). The cable 205 is operatively reeved about one or more pulleys 206 so that as the leg yoke 210 is pivoted on the fixed support 204, a tension force in the cable 205 may raise (or lower) the training load 208. Except for the particular characteristics of the leg yoke 210 and the pad assemblies 250, which will be described below, the overall operation of the leg exercise machine 200 is similar to the devices described in, for example, U.S. Patent No. 5,672,143 issued to Ish, U.S. Patent No. 5,395,295 issued to Ish, and U.S. Patent No. 4,900,018 issued to Ish *et al.*, which patents are incorporated herein by reference.

Figure 5 is an enlarged isometric view of a leg yoke 210 of the leg exercise machine 200 of Figure 4. Figure 6 is a top elevational view of the leg yoke 210 of Figure 5. As shown in Figures 5 and 6, the leg yoke 210 includes a pivot arm 212 having an upper end 214 that pivotably engages the fixed support 204. A base member 216 is attached to a lower end 218 of the pivot arm 212. The base member 216 includes a pair of pad supports 220 that project laterally from a central portion 222 of the base member 216 and which, in this embodiment, are contoured into a concave shape. Each pad assembly 250 is attached to one of the pad supports 220.

Figure 7 is a lower isometric view of one of the pad assemblies 250 of the leg exercise machine of Figure 4. Figure 8 is an exploded, cross-sectional end view of the pad assembly 250 of Figure 7. The pad assembly 250 includes a contoured backing plate 252 and a layer of compressible padding 254. A protective cover layer 256 extends over the compressible layer 254 and is attached to the backing plate 252, securing the compressible layer 254 to the backing plate 252 and protecting the compressible layer 254 from sweat or damage during use. The compressible layer 254 may be composed of, for example, foam or rubber padding, and the protective layer 256 may be neoprene, cordura, nylon, or other suitable protective material. In the embodiment shown in Figure 7, the protective layer 256 is attached to the backing plate 252 by stitching 258. A channel 260 is attached to the backing plate 252 by, for example, one or more rivets 262 (Figure 8). The channel 260 is sized to receive one of the pad supports 220 of the leg yoke 210 (Figure 6). As shown in Figure 9, the channel 260 may be replaced with one or more brackets 264. Retaining members 266 (*e.g.* screws, bolts, rivets, etc.) secure the pad support 220 to the backing plate 252 of the pad assembly 250.

Figure 10 is a top elevational view of the leg yoke 210 of Figure 5 engaged with a user's legs 270. In operation, the user may be seated on the bench 202 with the user's legs 270 (shown in cross-sectional view in Figure 10) engaged with the pad assemblies 250. As the user's leg 270 presses against the

protective layer 256, such as during a leg curl or leg extension exercise, the compressible layer 254 is compressed against the backing plate 252, and the protective layer 256 moves from an uncompressed position 272 to a compressed position 274. Because the backing plate 252 is contoured, a portion 276 of the compressible layer 254 is compressed to an approximately uniform-thickness between the user's leg 270 and the contoured backing plate 252.

The leg pad assembly 250 may advantageously improve the pressure distribution on the user's leg 270 during an exercise. Because the contoured backing plate 252 provides an approximately uniform-thickness portion 276 of the compressible layer 254 when the compressible layer 254 is compressed to the compressed position 274, the pressure distribution on the user's leg 270 may be approximately uniform, and an improved distribution of the compression force applied by the user may be achieved. The maximum pressure exerted on the user's leg 270 by the leg pad assembly 250 may be less than that which occurs in the prior art device, and may be more evenly distributed over the part of the user's leg 270 engaged against the leg pad assembly 250. Thus, the user may be less likely to experience discomfort during an exercise, and the user's satisfaction with the leg exercise machine 200 may be enhanced.

Figure 11 is a lower isometric view of a leg pad 300 in accordance with an alternate embodiment of the invention. In this embodiment, the leg pad 300 includes a compressible member 302 having a front surface 304 that engages with a portion of a user's body (not shown). The compressible member 302 also has a back surface 306 with a depression 308 formed therein. Threaded apertures 310 are disposed within the depression 308 and are attached to a stiffening strip 309 (Figure 13) embedded within the compressible member 302. In one embodiment, the stiffening strip 309 is a steel strip having a plurality of holes to improve the mechanical attachment of the compressible member 302 with the stiffening strip 309.

In the leg pad 300 shown in Figure 11, the compressible member 302 may be a unitary member formed of polyurethane or other suitably compressible material. Preferably, the compressible member 302 may be formed of a "self-skinning" polyurethane that is molded into the desired shape by, for example, injection molding. During the molding process, the self-skinning polyurethane forms a durable, aesthetically-pleasing outer surface.

Figure 12 is a partial isometric view of the leg pad 300 of Figure 11 installed on a leg yoke 210 of an exercise machine. In this embodiment, a portion of the contoured pad support 220 is fittingly engaged into the depression 308 disposed in the back surface 306 of the compressible member 302. Threaded members (*e.g.* bolts) 312 are engaged through the pad support 220 and into the threaded apertures 310 of the leg pad 300, securing the leg pad 300 to the leg yoke 210.

In operation, the user's leg 270 (not shown) is pressed against the front surface 304 of the compressible member 302. The compressible member 302 is compressed between the user's leg 270 and the pad support 220. Because the pad support 220 is contoured into a desired shape, an approximately uniform-thickness portion of the compressible member 302 may be formed as described above with respect to the preceding embodiments. The pad support 220 may be formed into any desired shape or radius of curvature, preferably a shape or radius of curvature that provides a compressed shape of the compressible member 302 that approximately corresponds with an anticipated shape of a surface of the user's leg 270 that contacts the front surface 304 of the compressible member 302.

Figure 13 is a cross-sectional view of the leg pad 300 of Figure 11. In this embodiment, the leg pad 300 and the contoured pad support 220 are adapted to engage against a user's shin. As best shown in Figure 13, the front surface 304 has a contoured portion having a radius of curvature of about 2.25 inches, the pad support 220 has another contoured portion having a radius of curvature of approximately 3.00 inches (signified by the bottom of the depression

308). Of course, as described above, many alternate embodiments may be conceived having varying radii of curvature for the front surface and the pad support (or backing surface). Generally, for most applications for pad assemblies for exercise machines, it is anticipated that the radii of curvature of these surfaces may typically vary within the range from about 1.5 inches to about 7.0 inches for engagement with most commonly contacted portions of a user's body, although greater or lesser radii may be employed. Furthermore, in alternate embodiments, the pad support 220 may be separate from the leg yoke 210, and may be separately or integrally formed with the compressible member 302. The pad support 220 may then be attached to either the fixed or moveable portions of the frame of the exercise machine for use.

Because the leg pad 300 does not require a backing plate 252, the leg pad 300 may advantageously provide the desired pressure distribution characteristics in a simpler, more economical assembly than the other embodiments described above. The contoured pad support 220 forms the relatively rigid backing structure which provides the approximately uniform-thickness portion of the compressible member 302 during use of the exercise machine.

Although the above-described embodiments of pad assemblies have been described as being engaged with portions of the user's arms or legs, it should be understood that, in alternate embodiments, pad assemblies in accordance with the invention may be readily conceived that engage other portions of a user's body. For example, exercise machines having pad assemblies in accordance with the invention may be conceived wherein the pad assemblies bear against a user's shins during a leg extension exercise as disclosed in U.S. Patent No. 4,776,587 to Carlson *et al.*, or bear against the back of a user's calf during a leg curl exercise as disclosed in U.S. Patent No. 4,509,746 to Mask, or bear against inside surfaces of a user's arms during a chest or "fly" exercises as taught in U.S. 5,716,308 to Lee, or bear against a user's shoulders or knees as taught in U.S. Patent No. 5,135,457. Other examples of exercise machines

having pad assemblies in accordance with the teachings of the present disclosure may be conceived.

The detailed descriptions of the above embodiments are not exhaustive descriptions of all embodiments contemplated by the inventors to be within the scope of the invention. Indeed, persons skilled in the art will recognize that certain elements of the above-described embodiments may variously be combined or eliminated to create further embodiments, and such further embodiments fall within the scope and teachings of the invention. It will also be apparent to those of ordinary skill in the art that the above-described embodiments may be combined in whole or in part to create additional embodiments within the scope and teachings of the invention.

Thus, although specific embodiments of, and examples for, the invention are described herein for illustrative purposes, various equivalent modifications are possible within the scope of the invention, as those skilled in the relevant art will recognize. The teachings provided herein can be applied to other apparatus and methods for pad assemblies for exercise machines, and not just to the embodiments described above and shown in the accompanying figures. Accordingly, the scope of the invention should be determined from the following claims.